Irritable Bowel Syndrome

Epidemiology, Pathophysiology, Diagnosis, and Treatment

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KEYWORDS

• Irritable bowel syndrome • IBS • Rome IV

KEY POINTS

- Irritable bowel syndrome is the most common functional gastrointestinal disorder.
- Symptom onset is commonly seen in early adulthood and has a female predominance.
- It has been proposed that the condition is a response to alteration in the complex interaction between the gut and nervous system.
- Diagnosis is based on clinical guidelines as defined by the recently updated Rome IV criteria.
- A variety of effective treatment options exist, including dietary modification, pharmacologic, and behavioral.

INTRODUCTION

Irritable bowel syndrome (IBS) is a common medical condition characterized by chronic, recurrent, abdominal pain and discomfort, and altered bowel habits that occur in the absence of other organic gastrointestinal (GI) disease. The diagnosis is based on the recently updated Rome IV criteria. IBS is characterized as a functional GI disorder (FGD). The underlying cause is still being defined but is thought to be multifactorial. Many treatments have been proposed, depending on the manifestation of symptoms, with variable efficacy. For many patients with IBS, quality of life is impaired and utilization of health care is increased.

The authors have nothing to disclose.

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CONTENT

Epidemiology

Worldwide prevalence of IBS is 10% to 15%.[1] IBS is frequently encountered in primary care and gastroenterology practices. It is the most commonly diagnosed GI disorder. It encompasses 25% to 50% of all referrals to gastroenterologists and is second only to the common cold for the number of days of work missed.[2] IBS often manifests in childhood, though peak prevalence seems to be in early adulthood. Women are affected in a 2:1 ratio to men and up to half of those afflicted seek medical care.[3,4]

Pathophysiology

FGDs are defined as common disorders characterized by persistent and recurring GI symptoms that are not caused by structural or biochemical abnormalities. Of the FGDs, IBS is most common in a group that includes dyspepsia, nausea, vomiting disorders, and proctalgia fugax.

The cause IBS is multifactorial and not completely elucidated. Several recent studies have led to new and novel hypotheses about the pathophysiology of IBS (**Box 1**). These hypotheses have led to the development of various therapeutic options. Often explained as a brain-gut disorder, it is understood that a complex interplay between the GI system and central nervous system leads to symptoms. Observation suggests that psychosocial stressors often precede the expression of symptoms and improvement is seen with therapies directed at the central nervous system.[5]

Inciting factors leading to disruption in GI motor and sensory function may include irritation from products of digestion, prior gastroenteritis, endogenous irritants, alteration in the gut microbiome, mucosal immune activation, food intolerance, and increased mucosal permeability. These underlying disruptions lead to symptoms of discomfort, altered gut motility, and change in bowel habits. Genetic factors may play a role in development of condition.[18]

Diagnosis

To standardize the diagnosis of FGDs, diagnostic criteria have been developed; the most widely used is the Rome criteria. The first iteration of the Rome criteria was proposed in the 1980s and has since been updated 3 times, most recently in 2016 with the Rome IV criteria. The Rome IV criteria updates and simplifies the widely used Rome III criteria and can be applied to a variety of patient populations. A comparison between the 2 criteria sets is explained in **Table 1**.

Diagnosing IBS with the Rome IV criteria necessitates that the patient have symptoms of recurrent abdominal pain on average at least of 1 day per week for the previous 3 months, with symptom onset at least 6 months before presentation. The criteria also necessitate that the patient have abdominal pain in association with at least 2 of the following:

1. Defecation (either improvement or worsening of pain)
2. Change in stool frequency
3. Change in stool form (appearance).[4]

Specific subtypes of IBS often drive treatment and care should be taken to classify patient symptoms into constipation predominant (IBS-C), diarrhea predominant (IBS-D), mixed (IBS-M), or unclassified (IBS-U). IBS-C is defined as having more than 25% of bowel movements classified as Bristol Stool Form Scale (BSFS) 1 or 2, with less than 25% of stools categorized as BSFS 6 or 7. IBS-D is classified as having more than 25% of stools categorized as BSFS 6 or 7, less than 25% as BSFS 1 or 2.

Box 1
Proposed pathophysiologic explanations about the cause of irritable bowel syndrome

Dysregulation of gut motility

Subjects with IBS received a lipid perfusion (to simulate food) and air infusion into the duodenum at a rate of 12 mL/min. Subjects with IBS had increased gas retention in their intestines, complained to controls, and had increased transit times of the gas from duodenum to rectum (IBS subjects had 500 cc of air in intestine vs 22 cc retention in healthy controls; saline [nonfood control] showed 250 cc retention in IBS).[6]

A separate study evaluated gas infusions alone and this also showed delayed transit times and retained gas in IBS subjects (IBS vs normal controls delayed transit time 30 vs 20 minutes, retrained gas IBS vs controls, 300 cc vs 50 cc).[7,8]

Visceral hypersensitivity

Subjects had a colonic balloon inflated to 3.4 cm in their large intestines. Six percent of controls versus 55% of IBS subjects had pain with the procedure.[3]

IBS subjects experienced an increased sense of bloat and distention compared with controls, with similar amounts of gas in gut. This may be associated with delayed small intestine emptying times in IBS subjects compared with controls.[7,9]

Inflammation

IBS subjects have increased mast cells, lymphocytes, TNF alpha, IL-6, LIF, NGF, IL-1beta in gut mucosa compared with controls, suggestive of inflammation. Additionally, gut mucosa cells that have increased inflammation are more permeable, leading to fluid leakage into the gut.[10]

Postinfectious

A large cohort study showed a 6-fold increase in development of IBS after infection (bacterial, viral, helminth or protozoan).

Risk factors included prolonged fever, prolonged infection, anxiety, depression, and younger age.

Possible causes include antibiotic usage, malabsorption (idiopathic bile acid absorption), and increased inflammation.[11]

Microbiomes

Healthy controls have distinctly different flora than subjects with IBS, and manipulation of microbiomes with antibiotics and probiotics has been found beneficial is some studies.[12]

Bacterial overgrowth (diagnosed with hydrogen breath tests) in some studies correlates with IBS symptoms. Improvements were observed after antibiotic treatment, though this was not demonstrated in all studies.[12]

Food sensitivity

The FODMAP diet has shown benefit in controlling subject symptoms. Additionally, removal of fructose, fructans, gliadin, sorbitol, and lactose from the diet has been beneficial for some subjects.

Subjects who are biopsy-negative for celiac disease but have elevated immunoglobulin (Ig)G antigliadin antibodies and are HLA-DQ2–positive (associated with development of celiac disease) showed improvement in IBS symptoms with a gluten-free diet.[13,14]

Genetics

IBS seems to have some familial trends, though twin studies failed to show a correlation, suggesting more of an environmental or social-learning component.[15]

Psychosocial dysfunction

Subjects with IBS take their children to the doctor more frequently than non-IBS counterparts. Subjects with increased traumatic life events (eg, relationship break-ups, job loss) have increased IBS symptoms; those with good social support had lower incidence of symptoms.

Subjects with IBS had higher rates of mood disorders (30%), suicidal ideation (15%–30%), hopelessness, anxiety (30%–50%), and somatization.[16,17]

Abbreviations: IL, Interlukin; TNF, tumor necrosis factor.

Table 1
Comparison of Rome III with Rome IV criteria for irritable bowel syndrome

	Duration	Frequency	Symptoms
Rome IV	≥3 mo of persistent symptoms with symptom onset at least 6 mo before diagnosis	**≥1 d per week**	Recurrent abdominal pain with at least 2 of the following criteria: 1. **Related** to defecation 2. Associated with change in frequency of stool 3. Associated with change in form of stool
Rome III	≥3 mo of persistent symptoms with symptom onset at least 6 mo before diagnosis	**≥3 d per month**	Recurrent abdominal discomfort or pain with 2 or more of the following criteria: 1. **Improvement** with defecation 2. **Onset** associated with change in frequency of stool 3. **Onset** associated with change in form of stool

Differences are in bold.

IBS-M is defined as greater than 25% constipated and greater than 25% diarrhea stools. IBS-U is defined as meeting other criteria for IBS without having greater than 25% of abnormal stools (Table 2).

Disorders such as inflammatory bowel disease, microscopic colitis, infectious diarrhea, GI cancers, and celiac disease can present with symptoms similar to IBS. For this reason, care must be taken to exclude these illnesses. A review of history and laboratory findings consistent with certain diagnoses can be seen in Table 3.

A careful history should largely distinguish IBS from other ailments. Bloating, abdominal distention, excessive straining during defecation, mucus with bowel movements, and urgency with defecation is commonly seen with IBS, though these symptoms are not specific. It is reasonable to question patients about rectal bleeding, unintentional weight loss, and a family history of colon cancer to screen for disease that may warrant more immediate evaluation. A dietary history can be helpful, as can a psychosocial history.

Historical elements that may lead the examiner to consider GI cancer include weight loss, rectal bleeding, abdominal pain, and increased age. Inflammatory bowel disease should be suspected with rectal bleeding, significant abdominal pain with diarrhea or obstipation, and a family history of autoimmune disease. Celiac disease may present with weight loss, diarrhea, family history of autoimmune disease, abdominal discomfort, and bloating. Infectious causes may be suspected in those with risk factors for

Table 2
Irritable bowel syndrome subtype classification

IBS Subtype	Frequency of Stool Character
IBS-C	>25% constipation, <25% diarrhea
IBS-D	>25% diarrhea, <25% constipation
IBS-M	>25% constipation and >25% diarrhea
IBS-U	<25% constipation and <25% diarrhea

Table 3
Differential diagnosis of irritable bowel syndrome and expected test results

Laboratory, Testing, Features	IBS	Infectious	Celiac Disease	Microscopic Colitis	GI Cancer	IBS
Anemia	+/–	+/–	+/–	–	+/–	–
Stool guaiac	+	+/–	–	–	+	–
Elevated white blood count	+/–	+	+/–	–	–	–
Fecal calprotectin	+	+/–	+/–	–	+/–	–
Fecal leukocytes	+	+	+/–	–	+/–	–
Elevated C-reactive protein Erythrocyte sedimentation rate	+	+	+	–	–	–
Tissue transglutaminase immunoglobulin (Ig) A	–	–	+	–	–	–
Endoscopic abnormality	+	+	+	–	+	–
Abdominal imaging	+/–	+/–	+/–	–	+/–	–
Abnormal biopsy	+	+	+	+	+	–
Historic identifiers	Age of onset 15–40 y, blood in stool, abdominal discomfort	Risk factors for infection	Chronic diarrhea, weight loss	More common in elderly, intermittent diarrhea	Older age, family history, bloody stool	—

Indicators: +/–, may be present; –, seldom present; + often present.

Clostridium difficile, giardia, or with fever and severe or bloody diarrhea. Microscopic colitis may cause chronic or intermittent diarrhea but generally does not cause significant abdominal discomfort or bloating.

A limited diagnostic approach should be undertaken and primarily used to rule out other disorders difficult to distinguish by patient history alone. It is reasonable to obtain a complete blood count to evaluate for anemia or leukocytosis, which suggests a different cause and warrants further testing. It is also reasonable to check a C-reactive protein or fecal calprotectin to exclude inflammatory bowel disease. In those with IBS-D symptoms who fail to respond to initial empirical treatment, serologic testing for celiac disease may be warranted. An esophagogastroduodenoscopy and small bowel biopsy should be considered if serologic testing for celiac disease is positive or if a high clinical suspicion remains despite negative serologic testing. Stool studies for infectious diarrhea can be performed if there is a high clinical suspicion. Colonoscopy should be performed for colon cancer screening in those who warrant screening or for those with rectal bleeding, a family history, or suspicious symptoms. In some instances, colonoscopy may be warranted in those with diarrhea who fail initial therapy, with random biopsies of the colon to rule out microscopic colitis. See **Fig. 1** for a suggested diagnostic approach.

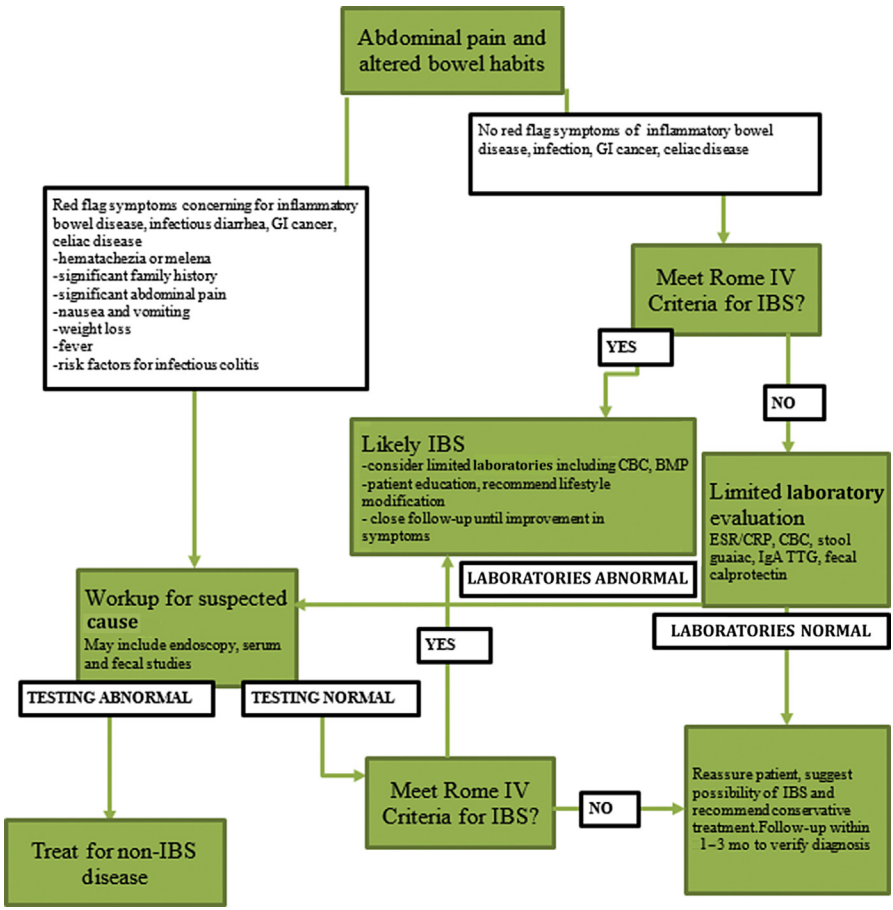

Fig. 1. Algorithm for evaluation of suspected IBS. CBC, complete blood count; CRP, C-reactive protein; ESR, erythrocyte sedimentation rate; Ig, immunoglobulin.

Table 4
Initial treatment of irritable bowel syndrome, including dietary changes

IBS Initial Treatment		
Initial therapy	Focus on removing gas-producing foods, lactose avoidance, and following a FODMAP diet. Once symptoms are under control, patients can start to add back foods (1–2 new foods a week). If symptoms recur with newly added food, long-term avoidance of that food should be implemented.[24]	
Removal of gas-producing food	Remove beans, pork, cabbage, broccoli, Brussels sprouts, wheat germ, high carbohydrate, fructose, gluten from diet. Patients who remove gas-producing foods have symptoms improvement.[25]	
Lactose avoidance	Diagnosed with lactose breath test Individuals who are not lactose intolerant may react to other components in milk[26]	If lactose intolerant, likely benefit from restriction If negative breath test, patient may benefit from trial of lactose reduction if other interventions fail[26]
FODMAP	FODMAP refers to foods that increase gas in the gut and which can result in discomfort. Patients following a low FODMAP diet showed improvement in scores for abdominal pain, bloating, flatulence, and dissatisfaction with stool consistency.[20,26]	
	Low FODMAP, consume	**High FODMAP, avoid**
Fruits	Bananas, berries, melons (except watermelon), cranberry, grape, citrus, rhubarb Small quantities of dried fruit	Apple, mango, pear, dried fruits, canned fruits, watermelon, peach, plum, prunes
Vegetables	Bok choy, bean sprouts, red bell pepper, lettuce, spinach, carrots, chives, cucumber, eggplant, green beans, tomato, potatoes, water chestnuts	Artichokes, asparagus, sugar snap peas, cabbage, onions, shallots, leek, garlic, cauliflower, mushrooms, pumpkin, green pepper
Milk products	Milk: almond, coconut, hazelnut, hemp, rice Lactose-free milk, kefir, ice-cream Butter, half and half, cream cheese Hard cheese (eg, cheddar, Swiss, brie, bleu)	Milk: cow, sheep, goat, soy, evaporated, sweet and condensed Yogurt Cottage cheese, ricotta, mascarpone cheese Ice cream, frozen yogurt, sherbet
Grain	Brown rice, oats & oat bran, quinoa, corn, gluten free bread, cereals, pastas and flours	Wheat, rye, barley, spelt
Legumes	Tofu, peanuts	Chicken peas, hummus, kidney beans, baked beans, edamame, soy milk, lentils
Nuts & seeds	1–2 tablespoons almonds, macadamia, pecans, pinenuts, walnuts, pumpkin seeds, sesame seeds, sunflower seeds	Pistachios
Sweeteners	Sugar, glucose, pure maple syrup, aspartame	Honey, agave, high-fructose corn syrup, sorbitol, mannitol, xylitol, maltitol, Splenda
Protein	Fish, chicken, turkey, eggs, meat	
Oils	Olive and canola oil, olives, small amount avocado	

Table 5
Symptomatic treatment of constipation predominant irritable bowel syndrome

IBD-C Constipation Variant Specific Treatment	Dose	Mechanism of Action	Benefit, Harm, Cost per Month
Goal: regular bowel movements	Goal: 1 easy to pass bowel movement a day		
Nonsoluble fiber	25–30 g a day	Stool softening	May be beneficial in IBD-C only, in reducing constipation Not beneficial in IBS compared with placebo for abdominal pain or bloating and generalized IBS symptoms[22] $5–10
Soluble fiber			No benefit
PEG 3350	17 g qd–qid (titrate to goal)	Increases stool water retention	Improves symptomatic constipation but not, abdominal bloating or pain[21] $12
Lubiprostone	8 mcg po bid	Activates chloride channels, increasing fluid secretion and gut mobility	Subjects had increased satisfaction with stooling (18% vs 10% placebo of patients who reported satisfied or very satisfied with stopping pattern) Number need to treat (NNT) = 12.5[27] $300
Linaclotide	290 mcg po qd	Activates guanylate cyclase-C, stimulating cGMP production to increase fluid secretion and mobility	Improved abdominal pain, increased bowel movements (34% vs 21% placebo)[28] NNT = 7.7 $350
Water	8 glasses a day	Maintain hydration	Most investigators agree a good idea, but minimal data to suggest benefit unless significant dehydration is present There are no documented harms[29]

Cost estimates taken from goodRx.com.
Abbreviation: cGMP, cyclic guanine monophosphate.

Treatment

Initiation of treatment of IBS starts with identifying the severity and predominant symptoms of the disorder. If symptoms do not significantly affect quality of life, management with lifestyle modification and education is a reasonable choice. Patients should be reassured about the benign course of IBS and counseled on treatment options. Limited studies suggest that exercise can be beneficial in improving symptoms.[19] Dietary changes are a cornerstone of lifestyle modification and focus on decreasing fermentable foods. The diet low in fermentable oligosaccharides, disaccharides, monosaccharides, and polyols (FODMAP) has been shown to reduce symptoms in patients with IBS.[20,21] Decreasing fermentable foods likely reduces gaseous distension, thus altering the pain response. Though supplemental fiber has long been recommended as therapy for IBS, it may worsen pain in some individuals with IBS-C disease and may be of marginal benefit in others (**Table 4**).[22,23]

Patients with IBS-C may benefit from specific treatment of constipation. Polyethylene glycol (PEG) is a safe initial treatment of constipation but may not alter the pain response.[27] If constipation symptoms persist or if the patient is unable to tolerate PEG, the addition of lubiprostone or linaclotide is reasonable (**Table 5**).

IBS-D disease is often treated with preprandial loperamide, which has been shown to the decrease number of loose bowel movements but may not alter abdominal discomfort.[30] Patients who fail loperamide alone may additionally benefit from bile acid sequestrants such as cholestyramine.[31] Bile acid sequestration impairment is a likely mechanism for symptomatology in some patients. Female patients who fail other therapy for severe IBS-D symptoms may benefit from treatment with 5-hydroxytryptamine (5-HT) type 3 antagonists such as alosetron, or ondansetron[3,32] (**Table 6**).

Symptomatic treatment of abdominal pain in IBS, regardless of subtype may be accomplished with several classes of medication. Antispasmodics, including dicyclomine and hyoscyamine, can be dosed on an as-needed basis and have been shown to be beneficial in short-term symptom relief. Peppermint oil, which has antispasmodic activity, has been shown to provide significant symptom relief but may exacerbate heartburn (**Table 7**).[22]

Tricyclic antidepressants are the best studied antidepressant to improve IBS symptoms, including pain, and may improve slow colonic transit times and diarrheal symptoms. Selective serotonin reuptake inhibitors have also been shown to improve symptoms over placebo, while serotonin and norepinephrine reuptake inhibitors have little evidence to support their use.[22] Of complementary therapies, cognitive behavioral therapy and exercise are the most likely to be of benefit and help patients reduce and manage pain symptoms[38–43] (**Table 8**).

Treatment of bloating and discomfort may be accomplished through alteration of disrupted bowel flora. To this end, probiotics may be beneficial in reducing symptoms though it is unclear which products or strains of bacteria are best recommended. In patients who have failed other therapy, and especially those with diarrhea, the antibiotic rifaximin is approved for IBS and may offer benefit.[44–47] (**Table 9**).

SUMMARY

IBS is the most common FGD. Symptom onset is commonly seen in early adulthood and has a female predominance. It has been proposed that the condition is a response to alteration in the complex interaction between the gut and nervous system. Genetic and psychosocial factors likely predispose certain populations to IBS. Diagnosis is based on clinical guidelines as defined by the recently updated Rome IV criteria. It is important to distinguish between IBS-D, IBS-C, or IBS-U diseases to guide

Table 6
Symptomatic treatment of diarrhea predominant irritable bowel syndrome

IBD-D	Treatment or Pharmacology	Dose	Benefit or Cost
Goal: decrease excessive bowel movements	1–2 bowel moments a day		
Loperamide	Binds gut wall opioid receptor Increases sphincter tone	4 mg po × 1, then 2 mg with each additional loose stool Maximum 16 mg/d	Decreased stool frequency but no change in bloating, abdominal discomfort, or global IBS symptoms $240/mo[33]
Phenobarbital (P) Hyoscyamine (H) Atropine (A) Scopolamine (S)	A + H + S antagonizes acetylcholine at muscarinic receptor, relaxes GI smooth muscle, decreases GI motility, decreases GI secretion, P sedates	16.2 mg/0.1037 mg/0.0194 mg/0.0065 mg 1–2 tabs po q 6–8 h	Minimal available data Seems to help non-GI symptoms (sleep disturbances, nervousness) better than GI symptoms (abdominal pain and bloating) $1300/mo[34]
Eluxadoline	Binds to various opioid receptors inhibiting peristalsis	100 mg po bid	NNT = 10 for improvement in diarrhea and abdominal pain NNH = 16 for constipation as a side effect $1000/mo[30] Contraindicated in patients with history of cholecystectomy

Ondansetron	5HT3 receptor antagonist	4–8 mg po q 8 h	Improves stool consistency, frequency, urgency No difference in abdominal pain $13–1000 depending on formulation[35]
Alosetron (female patients only)	$5HT_3$ receptor antagonist	0.5 mg–1 mg po bid	Global improvement in IBS symptoms Was withdrawn from US market due to side-effects, then reinstated with restricted access NNT = 7 $700–1000/mo[36]
Tegaserod	$5HT_4$ agonist		Withdrawn from US market due to cardiovascular side effects[37]
Bile resin binders Cholestyramine Colestipol Colesevelam	Binds bile acids, which can cause increased stool transit times	Colesevelam 1.875 g po bid	Decreases stool transit times to the ascending colon by 50% (14.5 h in colesevelam group vs 10.7 4-h placebo) May increase bloating and constipation $50–500, depending on formulation[19]
Fiber	Bulkier stools absorb extra water	Various	Harmful, no benefit and may worsen symptoms[22]

Cost estimates taken from goodRx.com.

Table 7
Treatment of abdominal pain and spasm

IBD, Abdominal Pain or Spasm	Dose	Mechanism of Action	Benefit or Cost
Antispasmodics			
Dicyclomine Hyoscyamine	20–40 mg po qid 0.125–0.25 mg po q 4 prn	Antagonizes acetylcholine at muscarinic receptors, smooth muscle relaxer, inhibits bradykinin, reduces histamine induced spasm	Beneficial NNT = 7 improvement in abdominal pain NNT = 5 improvement in global assessment NNT = 3 for improvement in global symptom score $ 5–20[22]
SSRIs & TCAs	Citalopram, fluoxetine, paroxetine, amitriptyline, desipramine, doxepin, imipramine, trimipramine	Various	NNT = 5 abdominal pain improvement NNT = 4 global symptom score improvement[22] (Cochrane review pooled all TCAs and SSRIs in review)
Peppermint oil capsule	0.2–0.4 mL tid	Smooth muscle relaxer; reduce gastric motility by acting on calcium channels (similar to dihydropyridine calcium antagonists)	Beneficial NNT = 2.5 to improve IBS symptoms. $10[22]
Exercise	3–5 times a week vigorous	Possible increased motility, increased absorption of gas from gut	NNT = 7 for >50% decrease in pain[32]

Cost estimates taken from goodRx.com.
Abbreviations: SSRIs, Seritonine specific reuptake inhibitors; TCAs, tricyclic antidepressants.

Table 8
Complementary treatment of pain in irritable bowel syndrome

IBS, Complementary Treatment	Dose	Mechanism of Action	Benefit
Cognitive behavioral therapy	Weekly–monthly	Help patients come to grips with pain	NNT = 4 to prevent persistent IBS symptoms[31]
Acupuncture	Various	Uses small needles placed in acupuncture points to promote realignment of qi (chee) and promote the body's self-healing Heat, pressure, and electricity may be used with the needles Massage, cupping, and placement of herbs on the body is considered part of acupuncture treatments	Sham vs real acupuncture resulted in similar improvements Acupuncture vs pharmacologic therapy showed acupuncture therapy superior 84% vs 63% had improvement in severity score[38] Acupuncture equal to probiotic and psychotherapy in effectiveness[38]
Hypnotherapy	Various	A state of human consciousness used to increase attention and decrease focus on peripheral stimuli Increases ability to respond to peripheral suggestion	Hypnotherapy superior to doing nothing and standard care for abdominal pain on IBS symptom score based on small low quality studies[39]
Herbal therapy	Various Several small trials of traditional Chinese herbal medicines & Iraqi traditional medication	Reduce flatulence and abdominal pain No clearly defined mechanism	Studies generally were favorable for improvement in overall symptoms score, decreased abdominal pain, and decreased flatulence (small studies with low methodologic quality)[40,41]
Homeopathic	Variable	Based on the hypothesis that substances that create harmful symptoms in healthy people will cure those same symptoms in sick patients	68% of subjects had benefit compared with 52% taking placebo on global symptom scale (3 low quality randomized controlled trials showed small benefit)[42]
Exercise (see Table 7)			

Table 9
Treatment of bloating in irritable bowel syndrome

IBS, Bloating	Dose	Mechanism of Action	Benefit or Cost
Probiotics	Various doses and concentrations (difficult to conduct meta-analysis due to lack of standardization)	Repopulate the gut with more efficient bacteria	*B infantilis* 35,624, *Lactobacillus*, *Streptococcus* in various combinations most effective in IBS NNT = 4 to prevent worsening global IBS symptoms[43,44] Most effective in reducing symptoms of bloating[45] Not effective in reducing overall IBS symptoms[45]
Prebiotics	Various	Predigested food	Not effective[45]
Rifaximin	550 mg po tid × 14 d (may repeat twice for recurrent disease)	Presumed decrease in gas-producing bacteria	NNT = 11 for improvement in IBS symptom score NNT = 9 for improvement in bloating Effective diminishes after medication is discontinued[46] $2000 Beneficial in IBD-D
Neomycin	500 mg po bid × 14 d	Presumed decrease in gas-producing bacteria	NNT = 3 for improvement in IBS composite score NNT = 7 for improvement in constipation symptoms[47] (beneficial in IBD-C)
FODMAP	See previous table	Decreases fermentable gas-producing foods	Following FODMAP diet improved overall combined symptom score by 50%, increased quality of life, and decreased frequency of pain No change in severity of pain or bloating[20]

Cost estimates taken from goodRx.com.

Data from Thabane M, Kottachchi DT, Marshall JK. Systematic review and meta-analysis: the incidence and prognosis of post-infectious irritable bowel syndrome. Aliment Pharmacol Ther 2007;26(4):535–44; and Brandt LJ, Chey WD, Foxx-Orenstein AE, et al, American College of Gastroenterology Task Force on Irritable Bowel Syndrome. An evidence-based position statement on the management of irritable bowel syndrome. Am J Gastroenterol 2009;104(Suppl 1):S1–35.

treatment. Limited diagnostic evaluation should be performed to exclude other organic disease. Treatment is based on a trial of lifestyle changes and symptom management. The low FODMAP diet and exercise should be recommended for lifestyle changes. In IBS-C disease, fiber is of limited benefit and laxatives may be helpful. In IBS-D disease, loperamide may be an appropriate therapy, followed by atrial of bile acid sequestrants and 5-HT_3 antagonists. Pain and bowel cramping can be treated with antispasmodics and peppermint oil, tricyclic antidepressants, counseling, probiotics, or a trial of rifaximin.

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